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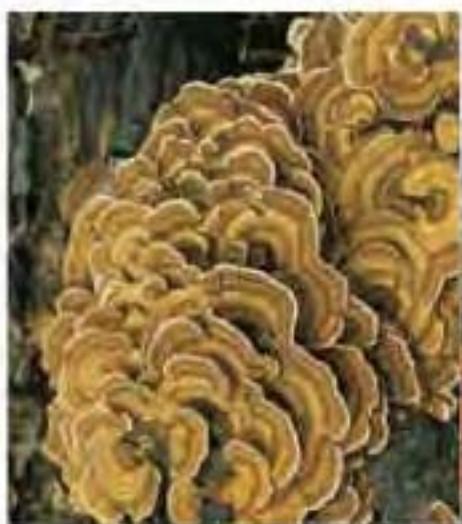
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Cover photos by Scott Myers

The Chief

BIG MAN; BIGGER MISSION

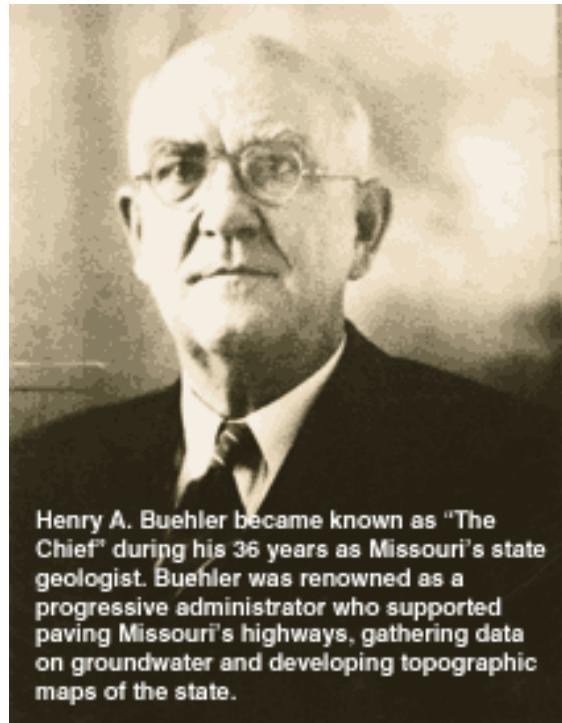
by H. Dwight Weaver

On April 12, 1853, George C. Swallow, newly appointed Missouri state geologist, received his commission from Missouri Gov. Sterling Price. Swallow distinguished himself in several ways, but is best known as Missouri's first state geologist. Little did he know that the mission he took on would long outlive him.

Seventeen geologists have served Missouri as state geologist since Swallow's time. Of those, only three have been in office 10 years or more and only one – Henry A. Buehler – has held the office longer than 15 years.

Henry A. Buehler, affectionately known as "The Chief," served as Missouri's state geologist for 36 years and his record goes beyond the boundaries of what is normally expected of a state geologist.

Swallow's commission was a very tall order. He was to make a "thorough geological and mineralogical survey of the state, with a view to determine the order, succession, arrangement, relative position, dip or inclination, and comparative magnitude of the several strata, or geological formations within the State ... to discover and examine all beds or deposits of ore, coal ... and other such mineral substances, and mineral waters, as may be useful or valuable ... and to make a full and complete geological and mineralogical survey of the State."



Henry A. Buehler became known as "The Chief" during his 36 years as Missouri's state geologist. Buehler was renowned as a progressive administrator who supported paving Missouri's highways, gathering data on groundwater and developing topographic maps of the state.

Innocence has its shortcomings and often lacks vision. The 1800s were horse-and-buggy days. The invention and development of the tools and technology needed to fully examine and evaluate the geological and mineralogical resources of the state simply were not available – and would not be until well into the 20th century.

"It has been a long time since Swallow was given his mission and we still haven't adequately accomplished it," said Tom Thompson, principal geologist at the Missouri Department of Natural Resources' Geological Survey and Resource Assessment Division (DNR/GSRAD). "But we have certainly tried. It's just that the magnitude of Swallow's mission was so enormous. The survey, of necessity, has to be a long-term project, and there is no end in sight."



Henry Buehler (second from left) joined Gov. Herbert Hadley (fourth from left) and the Missouri Board of Immigration on float trips along the Current and White rivers to promote the natural resources available in the Ozarks to prospective homesteaders.

What complicates matters for today's geologists, Thompson explained, is that we must be responsible and evaluate the environmental consequences of our decisions to extract or use our natural resources. It is important that we use them in a manner that neither threatens to deplete them nor harms the environment or us.

"While we are still very busy surveying the geological and mineralogical resources of Missouri, our purposes are somewhat different," said Thompson. "Today, we are also focused on interpreting the geology of specific sites that are under investigation for one reason or another. Back in Swallow's day, they didn't worry about hazardous substances that might contaminate our water. They didn't worry about the installation of huge sewage treatment systems to accommodate our continually growing population. They weren't building super highways and installing pipelines that extend for thousands of miles for the transportation of potentially hazardous materials."

Since 1853, each of Missouri's 17 state geologists has worked arduously to accomplish

that original mission and also meet the demands of their generation. State geologists, as well as their staffs, must cope with the realities of political pressure and limited financial resources. For some former state geologists, the lack of adequate funds and the politics of their time proved to be debilitating factors. For the most part, state geologists try to avoid external pressures that may serve to influence the results of their investigations.

Probably no better example of a state geologist's ability to rise above political pressure and become a legend is that of Henry Andrew Buehler who served as Missouri state geologist from 1908 to 1944. He was so well known and respected in his day that virtually everyone referred to him as "The Chief."

Buehler was born in Monroe, Wis., on May 27, 1876. He received a bachelor of science degree in 1901 from the University of Wisconsin. While at the university, he became acquainted and associated with W. R. Buckley who was serving as the state geologist of Wisconsin. Buckley was asked to accept the position of state geologist of Missouri in 1901 and Buehler became his assistant immediately after graduation from college. With the exception of one year, Buehler remained an employee of the state of Missouri all of his life.

When Buckley resigned his position in 1908, Gov. Joseph W. Folk appointed Buehler to fill the job. The wisdom of the appointment, and the service of The Chief, are best exemplified by the fact that he was reappointed by each of 10 succeeding governors. Considering the nature of politics, that was a major accomplishment. With every change of administration, there were those who wanted to sweep Buehler out of office, but he persevered and largely without even having to defend himself. As Edward L. Clark, who succeeded Buehler, said: "Few people knew his politics – no one cared. He was accepted as being above party lines."

Buehler also possessed a great deal of personal charisma.

"He was a big man and he wore a 'ten gallon hat' like a cowboy," said a 1944 article on Buehler. Remarkably, this man is still so highly regarded that to this day one of his hats and his geology pick are preserved at GSRAD offices in Rolla.

"Physically and mentally he is a giant among men," wrote one admirer in 1942. "His eyes are a piercing brown under a forest of unbrushed eyebrows, and there is a general air of ruggedness about him which makes him distinctive – a mighty oak in life's forest."

Buehler was well over 6 feet tall and so broad-shouldered he looked like a professional basketball and football player combined. In almost every



In 1938, the state's Department of Business Administration's Division of Geological Survey and Water Resources included (from left) Henry Buehler, state geologist; H.S. McQueen, assistant state geologist; Jean McCaw, secretary; John Grohskopf, geologist; unidentified, Norman Hinckley, geologist; Mary Hundhausen, geologist; Clyde O. Reinoehl, geologist; and unidentified.

crowd, he towered above his colleagues. He had a deep, resonant voice. The Chief's voice was so well-rounded and powerful, it was said that he probably could have become a great singer if he had trained for it.

The Chief had a remarkable ability for making friends, a skill that sprang from a strong inner liking and respect

for people. "He was always interested in people and not only willing to give information but constantly seeking it," said a contemporary. One story recounted about Buehler demonstrates how he felt about public service and how his example influenced his colleagues.

"He told me about one time when he spent two days with a poor country man down in the Ozarks who had dug a shaft 60 feet deep on what he thought was a gold mine," said Walter F. Pond, a geologist who had worked for Buehler. "The deep sympathy of his voice while talking about the poor man's delusion and hopes and desperation at not finding anything, and the account of how The Chief had spent two days in the poor man's cabin, teaching geology to him and finally reconciling the man to his disappointment, made such an impression on me that I have never since laughed at anyone's honest ignorance of geology ... or delusions of gold mines. The poorest taxpayer, even though he be so poor that he pays only indirect taxes, is as much entitled to our consideration and advice as the biggest ... corporation in the state I count myself very fortunate to have worked under The Chief for nearly eight years."

In the early days of office, The Chief was still laboring without the benefit of good roads and automobiles. An assistant of Buehler's was sent out to do a piece of work that required considerable traveling away from the railroads so a span of horses and a buggy were hired. Heavy rains came, and at one ford the rig was caught by a rush of water. The buggy overturned, the horses were swept off their feet, and the assistant narrowly escaped with his life. The horses were drowned, and a claim against the Geological Survey naturally was made. The state comptroller ruled that the claim could not be paid from regular appropriations and a bill was entered in the legislature to appropriate for the expense. But the bill was voted down, whereupon The Chief paid off the claim out of his own pocket because he didn't want the Geological Survey to have a reputation for not paying its bills. A good reputation meant a lot to Henry Andrew Buehler.

Buehler's geologic interests were wide. While most of his energy and time were occupied with the economic geologic resources of the state, he also was deeply

interested in topics such as physiography, paleontology, stratigraphy and the application of geophysics. "He practiced the precept that geology is the application of all sciences to the study of the earth," said William O. Hotchkiss of the Society of Economic Geologists.

Aside from his own research and early-day publications, Buehler was first and foremost an administrator. He was creative and progressive. He had a persuasive way of getting things done – like the paving of many Missouri highways; by taking the lead in getting the federal government to locate Fort Leonard Wood in the central Missouri Ozarks; by initiating the study of drilling residues to define the unseen stratigraphy beneath our feet; and by developing data on groundwater quantity and quality. He strongly supported the development of something else that was new in his day – topographic mapping. Today there are few maps more useful to Missourians from all walks of life than topographic quadrangle maps. They are used for everything from land surveying, highway building and law enforcement, to hiking, hunting and genealogical research.

Buehler's connection with other state departments contributed much to Missouri. He was an ex officio member of the Missouri Highway Commission and was attending a meeting of the highway commission at the Governor Hotel in Jefferson City on March 14, 1944, when he died suddenly of a heart attack.

American State Geologists meet in St. Louis



State geologists and acting state geologists honored Henry Buehler when they gathered in St. Louis during the 92nd annual meeting of the Association of American State Geologists. DNR photo by Jim Vandike.

During the week of June 18-24, 2000, Missouri hosted the 92nd Annual Meeting of the Association of American State Geologists (AASG) in St. Louis. The AASG is an organization composed of some of the nation's most competent scientists in the field of geology. A primary goal of the

The Chief's funeral was held at the Rolla Missouri School of Mines and Metallurgy (now the University of Missouri at Rolla) auditorium. So many attended the funeral that 3,000 people had to listen to speakers outside. Gov. Forrest C. Donnelly gave the eulogy. In it, the governor said: "That which one does for himself dies with him. That which one does for others lives on and is his monument."

Buehler left many monuments. He never married, but he spread his devotion and affection on underprivileged children, civic enterprises and worthy students. The latter he referred to as "his boys," and he took great pride in watching them develop into leaders of science and industry.

"Buehler was richly endowed with

AASG is to ensure that state objectives are met by federal science-based policies. Other goals include increasing and improving communication between state surveys and developing more effective work groups with others in the scientific community in support of their common interests.

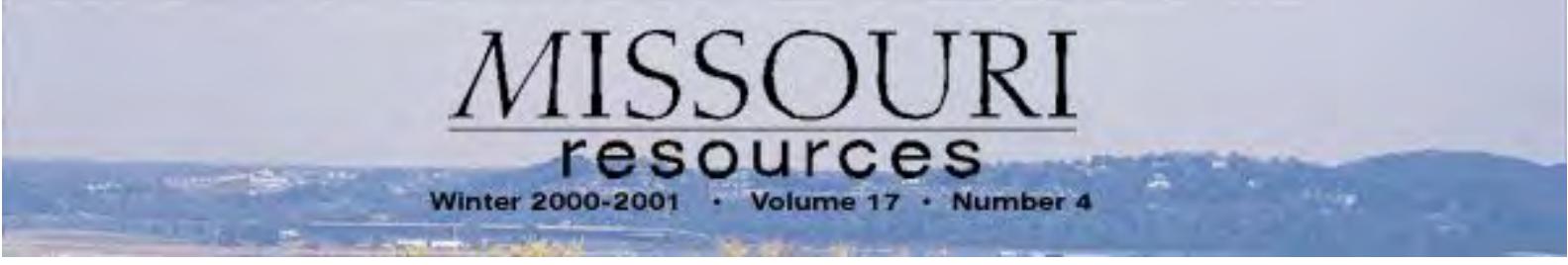
Forty-four states were represented at this year's annual meeting, which was organized by the Missouri Department of Natural Resources' Geological Survey and Resource Assessment Division.

The late Henry A. Buehler, Missouri state geologist from 1908 to 1944, was honored by a special exhibit at the convention. The late Gov. Mel Carnahan issued a proclamation naming the third week of June 2000 as "Chief" Henry A. Buehler Week.

qualities that endeared him to all who knew him," said Edward L. Clark, the state geologist who succeeded him. "His colorful and strong personality, straight thinking, utter frankness, genial friendliness, rough humor, code of ethics, originality and untiring devotion to assigned duties made him a man whose character, honesty and integrity were ever beyond reproach. His work is over, but his presence will continue to be felt."

Thus is the measure of Henry Andrew Buehler, The Chief, and the reason why he was honored in June of this year, more than half a century after his death, by the American Association of State Geologists, an organization that he helped found. His presence indeed is still felt in Missouri and throughout the United States wherever and whenever geologists gather.

H. Dwight Weaver currently is working part time for [DNR's Geological Survey and Resource Assessment Division](#). A recently retired division information officer, he still serves on Missouri Resources' editorial board. Weaver, whose articles in MR have garnered several national awards, also has authored three books on various themes including caves and their exploration. His most recent book, "Lake of the Ozarks: The Early Years," will be available soon. Weaver worked full time for the department for 15 years.



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OUT OF THE WOODS

TASK FORCE EXAMINES FOREST PRODUCTION

by Dan Schuette and Llona Weiss

photographs by Nick Decker

How do you enjoy Missouri's natural resources? Some of us like to hike wooded trails or float Ozark streams. Many bird-watch, photograph wildlife, fish or hunt wild game. All these activities are associated with or enjoyed in Missouri's forests. It would be impossible to participate in these recreational activities without access to our forest resources.

Almost one-third of the state is covered by forest, and two-thirds of the eastern Ozarks region of the state is forested. Forests are valued by Missourians for many reasons. Not only are they a source for wood products and habitat for wildlife, but the Missouri Department of Natural Resources (DNR) values them as sources of clean water, destinations for tourists, settings for other recreational activities and places for solitude and aesthetic appreciation. The forests of Missouri are an important resource for our citizens as well as for our tourists and visitors.

Missouri's forest resources have played a significant role in United States and Missouri history. In the 1800s, natural, virgin forests covered two-thirds of Missouri. Mature, natural forests of oak, hickory and shortleaf pine dominated Missouri with tall, open-floor forests. In the 1870s, wood was needed for American industry, railroads and western expansion.

The railroad industry was a huge consumer of Missouri timber resources. Millions of railroad ties were cut, and the Current and Black rivers were used for "tie drives," transporting millions of ties downstream. Timber also was needed to fuel the steam locomotive.

By the early 1900s, Missouri's timber resources were depleted. Early settlers cleared and burned remaining trees to create farm and pastureland. The Missouri Ozark hills, however, generally were too steep and rocky to establish pasture and produce row crops. Erosion soon clogged streams and impaired aquatic species. Wildlife, such as deer, turkey and many species of songbirds, were reduced to alarming levels. The timber industry moved west, where forest resources were still plentiful, allowing time for Missouri's forests to regenerate. Under the guidance of the United States Forest Service and the Missouri Department of Conservation, about one-third of the state, mostly in the Ozarks, has regenerated to healthy forests.

Within the last few years, two high-capacity chip mills began operating in southeast Missouri. Willamette Industries is located in Wayne County near Mill Spring, and Canal Wood Corporation is located in Scott County, near Scott City. Both mills currently are producing hardwood chips. Their combined expected output can be more than 500,000 tons of chips per year. Chip mills obtain their timber from within a 60- to 80-mile radius of their mills. A third, smaller chip mill also is operating in the state. Ozark Chip Company, in southwest Missouri, has been producing less than 100,000 tons of chips per year from sawmill residue. In addition, Westvaco Corporation purchases approximately 200,000 tons of wood per year in Missouri, three-quarters of which are chips purchased from sawmills. A typical Missouri sawmill produces between 24,000 and 32,000 tons of chips per year.



Modern timber-harvesting practices include the use of machinery such as this feller-buncher. From inside the cab, an operator maneuvers the machine into the forest where it slices off trees at the ground and strips their limbs. The bare stems are then loaded into the back of a truck for transport to a chipper. DNR photo by Nick Decker.

A Quandary, a Quest

In his executive order establishing the Advisory Committee on Chip Mills, the late Gov. Mel Carnahan directed the group to identify the impact of chip mills and associated forest-harvesting practices. Among the committee's assignments, members were directed to study:

1. Experiences in other regions of the United States.
2. Social, economic and environmental impacts for new and existing chip mills.
3. Potential environmental impacts to soil erosion, sedimentation, water quality, watershed protection, habitat loss, biological diversity, outdoor recreation and tourism.
4. Sustainability of Missouri's forest resources.
5. Capacity of Missouri's forests to sustain additional chip mills.
6. Impacts of chip mills on other forest-resource industries.
7. Long-term profitability of private forests.

Chip mills are large, highly mechanized facilities with powerful machinery that can take whole trees, strip the bark and then process the remainder into small chips. These chips then are used in the pulping process for paper mills. Missouri's Department of Natural Resources reviews applications and issues storm-water permits for chip mill facilities. Many people see chip mills as an opportunity to market lower-quality trees, the rough and rotten material that saw mills generally do not use. Others believe the large capacity of each chip mill, capable of consuming 20 acres of trees per day, encourages irresponsible harvesting of forest for quick financial gain.

Uncertainty surrounding these issues prompted the late Gov. Mel Carnahan to establish the Governor's Advisory Committee on Chip Mills. The committee was charged with examining potential environmental, economic and social effects of chip mills on Missouri's forests and its citizens.

The governor's advisory committee consisted of 14 members, including four state department directors, two state senators, two state representatives, two representatives of citizen environmental conservation groups, two forest product representatives, a forest landowner and a private property advocate. The directors of the departments of Natural Resources and Conservation were appointed as co-chairs.

The committee toured Missouri's forest resources, listened, discussed issues brought forth from technical research and public and special interest concerns, and read voluminous related material. No one knew where the chip mill path would lead when the committee began this endeavor in November 1998.

Committee members learned early that Missouri's forests play a vital role in protecting surface- and groundwater quality, controlling soil erosion, maintaining soil fertility, providing wildlife habitat and enhancing recreational opportunities. The forests are an important part of Missouri's natural landscape. The Department of Natural Resources provided the

products industry comprises many small mills producing lumber and a variety of related products. Much of the timber still is used for railroad ties, pallets, hardwood flooring and furniture stock. Missouri also is a significant charcoal producer in the nation.

committee with information on water quality, soil resource and protection goals, and recreational issues all related to chip mill facilities and our forest resources.

The study of this industry also revealed that chip mills and related harvesting practices were both an economic and environmental issue as well as an issue of heritage. "We pride ourselves on the quality of Missouri's environment, our unique culture and how we make a living in the Ozarks. Let's not forget that legacy," said DNR Director Stephen Mahfood.

The advisory group also learned that almost 85 percent of Missouri forestlands are controlled by more than 300,000 nonindustrial private forestland owners. Three-quarters of the land area surrounding the two high-capacity mills is privately owned. Thus, the majority of wood likely to be procured by the high-capacity chip mills will come from privately owned forest. In addition, it currently is estimated that only 10 to 15 percent of private forestland owners seek or receive advice or assistance from a professional forester in managing forests and timber harvesting.

In July 2000, the committee finalized its report to the governor. During this time, the department provided assistance to the committee with the help of the Missouri departments of Conservation, Economic Development and Agriculture by coordinating committee meetings, handling the receipt of public comments and providing general committee support and assistance. Thirty-five action statements were agreed upon and included in the report after considerable and often intense committee debate.

Cooperation, Compromise

In July 2000, The Governor's Advisory Committee on Chip Mills finalized its report and recommended action areas. The members agreed to 35 action statements, including the following:

- The establishment of a Forest Resources Council.
- Mandatory use of best management practices (BMPs) when an owner plans to remove 50 percent or more of the forest cover from more than 40 contiguous acres of forestland within the Ozark region.
- Funding by the General Assembly for a two-year study associated with chip mills and harvesting and a long-term research effort.
- Voluntary notification to the Missouri Department of Conservation prior to forest harvest.
- Support for a statewide certification-training program for loggers.
- Institution of a high-intensity forest landowner education effort in the areas providing timber sources for the chip mill facilities.
- Institution of strategies to reduce the demand for virgin wood pulp. These strategies should include recycling, reducing waste, and finding alternate sources of pulp fiber.

practices," said Mahfood, who



At the Willamette chip mill, a crane is used to move logs from truck to chipper. The wood chips then are loaded into railroad cars.

DNR photo by Nick Decker.

The report originally was scheduled to be released in December 1999. Because of the significant number of issues discussed, researched and debated, the committee was granted extensions and the report was completed in July 2000.

"We are emphasizing water-quality monitoring as it relates to timber-harvesting

co-chaired the committee. "This will help ensure we have the necessary data to better understand any environmental impacts associated with chip mills and related harvesting practices, specifically as it applies to water, soil and air quality issues."

In addition, the Missouri Clean Water Commission has directed DNR to not issue any storm-water permits to new chip mills. The department strongly supports this action, which is effective until April 20, 2002. The commission will develop a comprehensive plan and program for prevention of any potential pollution caused by storm-water runoff from chip mills.

The final report of the Governor's Advisory Committee on Chip Mills may be viewed on DNR's Web site at [www.dnr.state.mo.us/deq/chipmills]. A copy of the final report also may be obtained by calling Valerie Evers at 1-800-361-4827 or (573) 751-1010.

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Comments from the Director:



The last few months have been tough ones for me personally. Not long after Governor Carnahan's tragic death, I lost my grandmother, who was 94. It struck me as I was thinking about this issue's column that Governor Carnahan and my grandmother had a lot in common. They also both had a great impact on my life and the direction it has taken.

My grandmother, like Governor Carnahan, grew up in the Ozarks. There they learned how to deal with life. They were anchored by solid Ozark values: They accepted their friends and neighbors based on what those people did, not on what they said.

The land they called home and the environment were important to both of them. Stewards of the land, they understood that all of us working together can make a bigger difference than any one of us working independently.

I was called home to my grandmother's bedside while I was attending the second White River Basin Conference in Arkansas. Last year, at our first White River Basin meeting in Springfield, Governor Carnahan spoke about the importance of our two states working together to protect the water quality in the watershed. I had learned about the death of Governor Carnahan, his son Randy and aide Chris Sifford while I was on a canoe trip on the Current River, discussing with staff and other interested groups the work we needed to do together to protect that waterway.

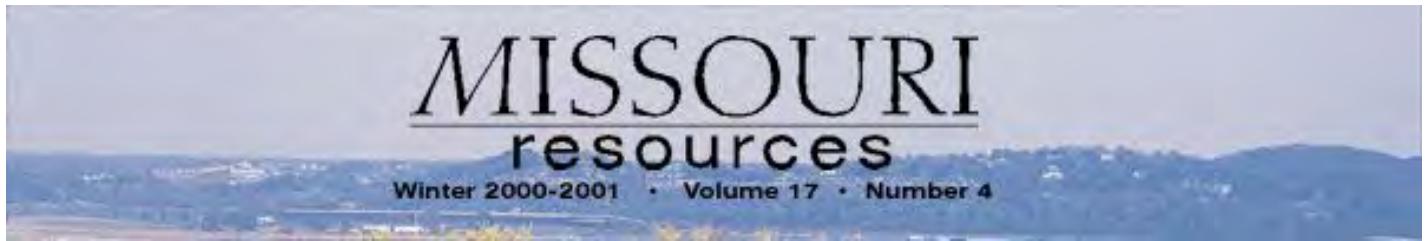
Both Governor Carnahan and my grandmother have left a legacy for me to live up to – one of quiet leadership based on good, solid, basic values. They both came out of the Ozarks, one of the most beautiful parts of our world. They were educated there with the basic Ozark philosophy of hard work and stewardship. Then they went out into the world to learn how others live. This combination makes for a great leader, whether you're a man or a woman, a governor or a grandmother.

I've had some time to reflect on these two people who meant so much to me. I am a better person for having known them, and I will miss them both. As we move forward into the transition to a new administration, I

will be relying on the life lessons they have passed on to me: to listen more than I talk, to give everyone an opportunity to be heard, to take care of Missouri's natural resources and to work hard. It is a critical time for all of us as we take on the tough issues, including improving air quality in St. Louis and water quality in southern Missouri.

Time and time again, I have seen Missourians step forward to protect and enhance their environment. I, too, am a firm believer in placing more faith in people's actions and not their words. As we head into a new year, we still need to heed the late governor's words and create local and regional partnerships that together will accept responsibility for ensuring that our legacy is a good one.

*Steve Mahfood,
Missouri Department of Natural Resources*



Letters

I just received [*Missouri Resources*](#) (Vol. 17 No. 3) and the [article on the Gateway Clean Air Program](#) seems to blow the DNR horn instead of informing. Is this intentional?

What I get from the article is that auto pollution is worse, despite spending untold billions over the years for pollution controls. That the air in the St. Louis area is worse even after the waste of taxpayers money, and the cost of automobiles (has) gone way up to "create" pollution devices. That the only way to improve the air is for the DNR to spend much more – forever and ever!

How about a honest article with a list of "improvements" in air quality to justify the costs? Or would this show what a waste of money the "improvements" are? What is the timetable to achieve (these goals)?

How is it possible for the air in Illinois, immediately across the river, to be good enough to not justify the cost of "improvement." Oh, the air blows away from Illinois? That must mean that the Mississippi stops the air at the rivers edge(?). Or that there is more political clout in Illinois, (so) that Illinois can shuck the EPA rules without penalty. Or?

David Wendt
House Springs

Editor's Note:

As indicated in the article, St. Louis air quality is not getting worse. It is getting better each year, and is cleaner now than it has been at any time in the last 20 years. This improvement is due in large part to the numerous air pollution controls that have been implemented throughout the region. The Gateway Clean Air Program is one of those many controls. Others include cleaner-burning gasoline, vapor-recovery equipment on gas pump nozzles, and numerous controls on industrial sources of volatile organic compounds (VOC) and oxides of nitrogen (NOx). Current data suggest the St. Louis region will meet Environmental Protection Agency (EPA) ozone

standards by 2004. However, EPA has proposed new standards that involve averaging ozone levels measured during eight-hour time periods. That proposal presently is subject to a court ruling. If enacted, these tougher requirements will demand additional time and increased ozone controls to bring the area into compliance.

Total vehicle emissions also are greatly affected by how much we drive, and we are continually driving more vehicles, more miles, each day and each year. Throughout the St. Louis vehicle-emission testing area, vehicles traveled more than 48.3 million miles per day back in 1996. The same area will log 54.4 million miles per day in 2000, and 62.3 million miles per day throughout the region in 2005.

The St. Louis metro region designated by federal agencies as an "ozone nonattainment area" includes a portion of metro-east Illinois. The Illinois "AirTeam" vehicle emission testing (nearly identical to ours) has been conducted since February 1999, about a year prior to the start-up of the St. Louis program.

I look forward to receiving each issue of *Missouri Resources*. They are always informative and interesting.

Since I have enjoyed it more than many of the magazines I subscribe to, I am enclosing a small payment to thank you for my free subscription.

Keep up the good work.

W. Dudley McCarter
St. Louis

Letters intended for publication should be addressed to "Letters," *Missouri Resources*, P.O. Box 176, Jefferson City, MO 65102-0176 or faxed to (573) 751-7749, attention: "Letters." Please include your name, address and daytime phone number. Space may require us to edit your letter. You also can e-mail *Missouri Resources* staff at moresdnr@mail.dnr.state.mo.us

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News Briefs

EIERA Contracts for Compost Study

The Environmental Improvement and Energy Resources Authority (EIERA) has contracted with the Mid-America Manufacturing Technology Center (MAMTC) to study the impact of mulch and compost on solid-waste management. MAMTC is a program of the Missouri Enterprise Business Assistance Center based in Rolla.

The three-month study cost \$8,000 and will be completed Feb. 1, 2001. The MAMTC staff will conduct surveys with each waste district to determine the location of mulch and compost sites, the availability of markets, feedstock sources and median prices for various product types, as well as the amount of mulch and compost collected annually. Interviews also will be conducted with buyers, sellers and users, such as nurseries, landscapers and retail outlets.

New Equestrian Trail Opens



Hikers and horseback riders have a new way to explore Johnson's Shut-Ins State Park in Reynolds County. On Sept. 30, the Missouri Department of Natural Resources dedicated the park's new 10-mile Goggins Mountain Trail for horseback riding and hiking.

Located in the park's Goggins Mountain Wild Area, the trail provides access to a scenic 5,000-acre wild area including Goggins Mountain. The loop trail provides vistas of nearby mountains, including Bell Mountain and Proffit Mountain. In addition to providing access to the wild area, the trail was created in response to a growing interest by state park users in more equestrian trails in the state.

Future plans include providing an equestrian campground in the area.

Another goal is to eventually connect with the Ozark Trail in the Bell Mountain Wilderness Area.

The trailhead includes parking for 15 vehicles and trailers, and a pit latrine. The trailhead is located three-quarters of a mile down Hwy. MM. Highway MM is located about 1,000 feet west of the entrance to Johnson's Shut-Ins State Park on Hwy. N, eight miles north of Lesterville.

Upgrades Improve Mapping Capability



The Department of Natural Resources' Geological Survey and Resource Assessment Division (GSRAD) recently began upgrading its primary software for its existing Geographic Information System (GIS) equipment. Seven new workstations also have been purchased and placed in the division.

"This upgrade improves our GIS capabilities for managing the division's earth science data and for creating new natural resource derivative maps for planning our resource-use activities," said Mike Gawedzinski, division GIS coordinator. "These products will include survey-control data, geologic maps, watershed maps, and environmental response and hazard maps."

"A long-term goal of the division is to have dedicated staff using this equipment to automate GSRAD historical information and make it accessible to the public," said Mimi Garstang, state geologist and director of the department's Geological Survey and Resource Assessment Division. "Advantages of GIS include the capability for rapid analysis of massive amounts of data to solve complex problems and manage real-time situations," Garstang added.

GSRAD recently demonstrated the extraordinary power of the new software for students at East Central College at Washington, Mo. The new equipment can be connected to a projector and shown on a larger screen or wall so that all of the students in the classroom are able to view exactly what the computer operator sees.

Watershed Data Pooled At Forum

More than 300 people attended the first annual Missouri Watersheds Conference held Sept. 8-9 at Tan-Tar-A Resort in Osage Beach. The two-day conference offered an opportunity to learn about topics such as Total

Maximum Daily Loads, water-quality monitoring, drinking water, the state water plan, laws, regulations and protecting Missouri's surface-and groundwater.

The conference began with opening remarks by Stephen Mahfood, director of DNR, accompanied by John Young, director of DNR's Division of Environmental Quality, and Mimi Garstang, director of DNR's Geological Survey and Resource Assessment Division. "As the director of DNR, I feel a great deal of personal responsibility and accountability to you and to all Missourians to protect the water quality of our state," said Mahfood. "You do too, or you wouldn't be sitting in this room today as one of our partners."

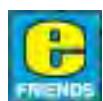
Young explained some of the many issues DNR deals with, including Concentrated Animal Feeding Operations, permitting backlogs and permit process efficiency, source-water protection and new drinking-water standards. "Our goal is that 15 to 20 years from now, environmental historians will call the first decade of the 21st century the decade of water," Young said. He also pointed out that DNR continues to move toward a watershed approach in the department's day-to-day efforts.

The forum was held to exchange ideas about water-quality challenges and how to make projects work. Groundwater Foundation from Lincoln, Neb. facilitated the forum.

Several organizations, universities and state agencies were represented among the nearly 40 conference displays.

For more information, call Becky Shannon of the [DNR Division of Environmental Quality's Water Pollution Control Program](#) at 1-800-361-4827 or (573) 751-1300.

"eFriends" Stay In Touch With Parks



People interested in Missouri state parks and historic sites have a new electronic source of information. People who sign up to become a Missouri State Park eFriend will receive periodic e-mails, letting them know about the latest developments, special events and new initiatives in Missouri state parks and historic sites.

"The new eFriends project is just one more way of letting our customers and constituents know what's going on in the state park system," said Douglas Eiken, director of the Missouri Department of Natural Resources' Division of State Parks. He explained that through the latest electronic

newsletter, eFriends were able to find out about the division's new Web pages, the new trail at Johnson's Shut-Ins State Park, special events for the fall and winter seasons, efforts to give a facelift to historic cabins, and how almost 400 people participated in the annual Wonders of the Outdoor World event at Roaring River State Park.

To become a Missouri State Park eFriend, send an e-mail to [moparks@mail.dnr.state.mo.us] or go to the Web site at [www.mostateparks.com/efriends.htm].

DNR Joins Meth Battle



The Missouri Department of Natural Resources (DNR) purchased 25 specially designed Methamphetamine Clandestine Lab Response Trailers to help protect the environment and keep law enforcement officers safe while dismantling meth labs. So far, 20 of the portable trailers have been delivered to drug task forces throughout Missouri for the cleanup of toxic waste produced by the meth manufacturing process.

Staff from DNR's Environmental Services Program (ESP) assist with the management and disposal of hazardous chemicals from clandestine drug labs. Waste chemicals can harm the environment if they are not disposed of properly, and they can be dangerous for law enforcement personnel to handle.

Local law officials are trained to collect the waste chemicals from drug labs and transport them to a collection station. ESP staff then can segregate, process and neutralize the hazardous materials. Staff then must arrange for the chemicals' safe and legal disposal. Previously, it cost several thousand dollars to clean up the waste chemicals from a drug lab. The new Meth Lab Response Trailers and hazardous materials handling system have reduced this to several hundred dollars.

To learn more about ESP call 1-800-361-4827 or (573) 526-3315; or visit ESP online at [www.dnr.state.mo.us/deq/esp].

Program Helps Cut Water Pollution

Farmers in selected Missouri watersheds can help protect drinking water and the environment by enrolling in the Conservation Reserve

Enhancement Program (MOCREP) through the Missouri Department of Natural Resources' Water Pollution Control Program. The \$85 million in federal funds will reduce pollution of streams and reservoirs that supply water to more than 375,000 Missouri residents and provide additional habitat for wildlife.

The 83 drinking water reservoirs that would benefit from the conservation and pollution-reduction program serve 58 public drinking water supplies in 36 Missouri counties.

Under MOCREP, farmers in sensitive watersheds can voluntarily take highly erodible and environmentally sensitive farmland out of production and plant grass, shrubs and trees and install riparian buffers and grass filter strips. The additional land cover and barriers help prevent runoffs that carry sediment and pesticides into water supplies. In return, producers receive cost-share and technical assistance.

The project area encompasses more than 489,000 acres in the drinking water reservoir watersheds, of which more than 155,000 acres are cropland. Up to 50,000 acres could be enrolled in the MOCREP program. Most of the targeted drinking water reservoirs are located near agricultural land.

Recycling Expert Conducts Seminar

Richard Keller, a national authority on recycling and waste-reduction issues provided a seminar for the Market Development Program staff at the Environmental Improvement and Energy Resources Authority (EIERA). The session was held Nov. 14 at EIERA offices, 325 Jefferson St., Jefferson City.

At the beginning of the year, the Market Development Program staff will be available to conduct workshops and seminars across the state. Keller provided helpful information to businesses and companies interested in establishing or expanding programs to buy recycled goods.

Keller is chief of recycling for Maryland Environmental Service, a consulting firm based in Annapolis. Last year, Keller received the Outstanding Market Development Award and in 1995 was selected the Recycler of the Year by the National Recycling Coalition based in Alexandria, Virginia.

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One Last Word

Inherently Unequal

by Tracey Berry

Arnedia Logan of Fulton attended the local George Washington Carver School. She now is a shareholder in a community center that operates out of the one-time segregated school.

The dilapidated shed at a Callaway County farm serves little purpose these days other than storage for straw bales. Nothing about the structure, whose future seems to rest precariously with the wind, indicates that its past is linked to the country's stormy civil rights history. There was a time though, when students, not straw, occupied the tumbledown shelter – a time when school integration was forbidden by law.



Arnedia Logan of Fulton attended the local George Washington Carver School. She now is a shareholder in a community center that operates out of the one-time segregated school. *DMN photo by Scott Myers*

While the 14th Amendment to the U.S. Constitution promised citizens equal protection under the law, the concept of "separate but equal" public facilities had been in effect since the late 1800s. In 1954, the Supreme Court confronted the question of whether

racial segregation in public schools deprived minority children of equal educational opportunities. The case, Brown vs. Board of Education, involved an African-American girl in Topeka, Kan. who had to cross the town to attend a segregated school. Chief Justice Earl Warren wrote for the court:

"We conclude that, in the field of public education, the doctrine of 'separate but equal' has no place. Separate educational facilities are inherently unequal."

Although integration would take decades to achieve in Missouri, the decision marked the beginning of the end for black schools.

To honor Black History Month in February, the Missouri State Museum in Jefferson City, operated by the Department of Natural Resources' Division of State Parks, will present the fifth in a series of black history displays. The feature will spotlight black schools in central Missouri.

"We want to document these things before they disappear," said John Viessman, museum curator. "If we didn't do this, these voices wouldn't be heard."

Some black schools fell into disrepair or were demolished. Others, such as Howard School in Warrensburg and George Washington Carver School in Fulton, benefited from community efforts to preserve them.

Viessman and William Woods University professor Gary R. Kremer have collected memorabilia and interviewed teachers and pupils about their integration experiences.

Among the most telling items are textbooks imprinted with the names of the schools where white children first used them. The outdated and worn books then were passed on to African-American students.

Arnedra Logan of Fulton attended Carver School in Fulton from 1940-1948. Her youngest of three children was in third grade in 1968 when Carver finally was integrated.

"I was saddened," Logan said. "It was like they were taking our school, it had always been our school."

Many African-Americans shared Logan's apprehension. Desegregation was not always an unmitigated good, Kremer said.

"A lot of black teachers lost their jobs. A lot of them had attended Lincoln University, but ... the supposition was their training was inferior," he added.

Logan agreed: "We had teachers who were interested in us getting the best and doing our best, and that's what we were required to learn. I would not trade my education

that I received ... for the education kids are receiving today."

The pre-integration schools exhibit will be open from 8 a.m. to 5 p.m., Feb. 21 through June 30 at the [Missouri State Museum](#) in the Capitol.

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Resource Honor Roll



Gov. Mel Carnahan and Jean Carnahan
Missouri Division of Tourism photo

The late Gov. Mel Carnahan worked tirelessly on behalf of so many causes that improved the day-to-day lives of Missourians. At times, his higher-profile initiatives may have overshadowed his environmental record, but it, too, is exemplary. His commitment to cleaner land, air and water surely will become part of the legacy he leaves to the people he served.

Some of the accomplishments achieved under Gov. Carnahan's leadership are clearly visible, such as the development of beautiful Route 66 State Park at what was once the

infamous Times Beach hazardous waste Superfund site; the continued cleanup of waste tire dumps; and the remediation of the Weldon Spring radioactive and hazardous waste site. However, other accomplishments that are equally important can only be measured using sophisticated scientific instruments that sample Missouri's streams and monitor the quality of our air.

From funding for rural sewage systems to improving the quality of Table Rock Lake and the White River Basin watershed, Gov. Carnahan fervently supported clean-water initiatives. Stream gauging and groundwater monitoring wells were increased throughout the state under his administration, as was assistance for local government wastewater treatment systems. The governor's signing of the Consumer Confidence Reports for Public Drinking Water gave Missourians the opportunity to make informed decisions about their drinking water.

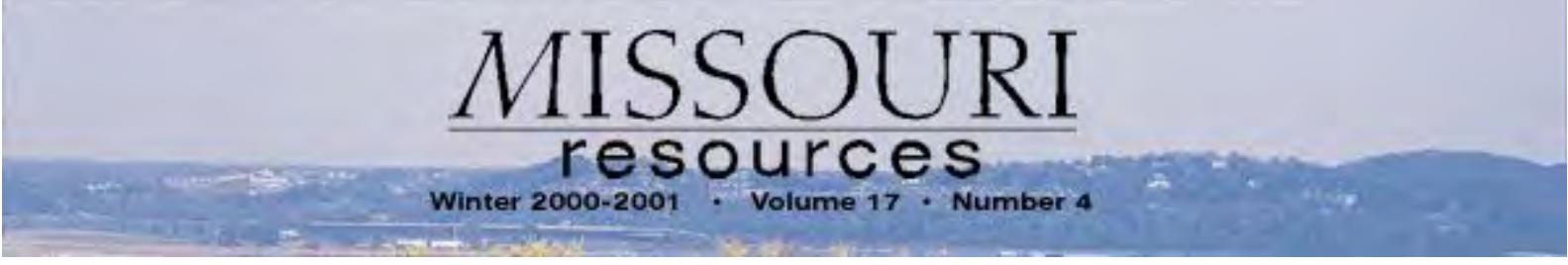
Gov. Carnahan also championed cleaner-air initiatives and legislation. He supported state participation in the Federal Reformulated Gasoline Program as well as the posting of air-quality data for ozone monitoring sites in Kansas City and St. Louis. The Gateway

Clean Air Program was implemented to bring the St. Louis area into compliance with federal clean air standards. Working with the U.S. Environmental Protection Agency (EPA), Missouri stepped up its efforts to reduce emissions from charcoal manufacturing facilities. Gov. Carnahan also responded to concerns about the safety of the gasoline additive MTBE by encouraging the EPA to make sure its use did not damage our nation's air or water quality.

The governor's methamphetamine initiatives have helped protect law enforcement officers and the general public during the handling, storage and cleanup of waste chemicals produced through the manufacture of this illegal drug.

Gov. Carnahan's proactive stance on resource protection led to the creation of the Governor's Advisory Committee on Chip Mills and the initiation of the "Green Building" concept for future state facilities.

This is only a brief summary of the many environmental initiatives Mel Carnahan pursued with unequaled energy and dedication. With his passing, the state of Missouri lost not only a great leader and devoted public servant, but also a champion of the environment for all of us



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Resources to Explore

Gen. John J. Pershing Boyhood Home State Historic Site

by Margaret Neeley

As an adult, Gen. John J. Pershing would be named general of the armies of the United States. Growing up in northern Missouri, he enjoyed hunting, fishing and making mischief. His childhood home in Laclede is now preserved as a state historic site.

A walk through Prairie Mound School provides visitors with a look into the life of a military leader. The school, where Gen. John J. Pershing taught, is now part of the Pershing historic site.

Nestled in the green hills of northern Missouri, just off the intersection of U. S. Highway 36 and Missouri Highway 5, is a small town named Laclede. While approximately 400 people call Laclede home, each year the community attracts numerous visitors from around the United States and overseas.

So what leads visitors off the beaten path to Laclede? Gen. John J. Pershing also called Laclede home. Pershing was recipient of the highest military ranking his country had to offer, general of the armies of the United States; only George Washington shares this title. Today, the Missouri Department of Natural Resources (DNR) preserves his home as Gen. John J. Pershing Boyhood Home State Historic Site.



As an adult, Gen. John J. Pershing would be named general of the armies of the United States. Growing up in northern Missouri, he enjoyed hunting, fishing and making mischief.

U.S. Army Photo 1914.

In 1859, the first railroad to span northern Missouri was completed from Hannibal to St. Joseph. John Fletcher Pershing and his new bride, Ann, moved into a section house along the Hannibal-St. Joseph Railroad, where he was employed as a railroad section foreman. John Joseph Pershing, the first of John and Ann's nine children, was born Sept. 13, 1860, in this section house. His father gained prominence in the affairs of Laclede as he bought the general store, became postmaster of the town, captain of the home guard during the Civil War and took an active role in his church.

On June 18, 1864, 3-year-old John J. Pershing, known as "Jack," encountered the violence of war for the first time. A band of Confederate irregulars attacked Laclede and killed several pro-Union men in town. Although John's father also was a staunch Union sympathizer, the Pershing family escaped injury. However, the Confederates did loot the general store.

When young Jack was 6 years old, the family moved into Laclede where, in addition to the general store, his father owned a lumberyard and was involved in land speculation. They purchased a house one block north of the town square, built during the period of 1857-1858 by Dr. Nathaniel Harris, one of the first

doctors to settle in this area. The Pershings paid a sum of \$4,000 for the home in 1866.

There is little in Pershing's boyhood history to suggest that some day he would become a national war hero. He experienced the usual boyhood pursuits of the time, including fishing, hunting, fighting and mischief-making. His aunt, Susan Hewitt, was known locally to make the most delicious apple turnovers, and young Jack seemed to know the right time to show up at the kitchen door of the Missouri House, a hotel run by Captain Hewitt, in hopes of being offered a sample.

The Panic of 1873 introduced young Pershing to the strenuous manual labor of farming. To supplement the family income during this time, Pershing's father went to work as a traveling salesman. Jack and his brother, James, became responsible for many of the chores on the family farm, located at the edge of Laclede. As the oldest child, it was his responsibility through the remainder of his teens to keep up his schooling, run the farm and act as head of the family while his father was on the road. This sense of responsibility was ingrained into young Pershing permanently.

The future general also took another job. He accepted a teaching position at Prairie Mound School, located nine miles out in the country, for \$30 per month. Pershing faced new challenges of drilling fundamentals into those pupils who came to learn and thumping discipline into those interfering with that process. This also included dealing with unruly parents whose children he had disciplined.

He saved enough money from teaching to enroll in the State Normal School at Kirksville (now Truman University) and received his bachelor's degree in scientific didactics on June 17, 1880. He continued teaching and farming, but his real ambition was to become a lawyer.

His life might have proceeded along the quiet channels of a small-town legal career if it were not for an article in the local newspaper. It stated that a competitive examination for the appointment of a cadet to the U. S. Military Academy at West Point would be held at the Trenton courthouse. The article went on to state, "All honest, strong, God-fearing boys of the district may take part."

A career as a professional soldier had never occurred to young Pershing until now. This was a chance to receive a free education. Eighteen candidates took the examination that summer in Trenton, with Pershing receiving the highest grades. The appointment to the military academy was his, provided he could pass the more stringent academic board requirements.



His childhood home in Laclede is now preserved as a state historic site.
DNR photo by Scott Myers.

In July 1882, Pershing reported to West Point as a "plebe," or freshman. While at West Point, he invented an early version of the jumping jack, using it as a form of hazing underclassmen. Each year, Pershing was elected to class office, eventually holding the highest rank of senior captain at graduation in 1886.

From this point forward, his life forever changed from the quiet rural pursuits to a soldier's rigors of self-sacrifice, duty and honor. Following graduation, he was commissioned a second lieutenant in the cavalry by President Grover Cleveland and entered the regular Army.

Pershing's first assignment was with the 6th Cavalry at Fort Baynard, N.M., against the Apache Indians led by Chief Geronimo. The 6th Cavalry was sent to fight in the Sioux campaign on the Dakota-Nebraska border in 1891.

Later that year, Pershing left his military unit to become a professor of military science and tactic at the University of Nebraska, where the Pershing Rifles were formed and became a national organization. He completed his law degree in his spare time and was admitted to the bar in Nebraska in 1895.

He liked college life, but wanted to be in the field where the action was. He was reassigned to the 10th Cavalry (an African-American unit) in Montana. By 1897, Pershing became an assistant instructor at West Point and was given the nickname "Black Jack" by the cadets because of his service with the 10th Cavalry.

His military accomplishments continued throughout his career. He was sent to France in 1917 as commander-in-chief of the American Expeditionary Forces in World War I. His tasks included organizing, training and supplying an inexperienced multinational force that eventually numbered more than 2 million soldiers. Through his leadership and diplomacy, Pershing also built a 500,000-man American force. Although the French and English had clamored for American soldiers to bolster their own regiments, Pershing realized that American bargaining power at treaty time would be hindered without a strong national combat identity. Less than three months after the U.S. troops claimed their first victory, World War I ended on Nov. 11, 1918. American military power and clout has continued to grow since Pershing's initial resistance to mix forces with the Allies.



A walk through Prairie Mound School provides visitors with a look into the life of a military leader. The school, where Gen. John J. Pershing taught, is now part of the Pershing historic site. DNJ photo by Scott Myers

Revival house. It is furnished in the style of the 1860s through the 1880s.

The Pershing family lived in the house until 1885, when they moved to Lincoln, Neb. In

When he returned in 1919, an act of Congress named Pershing general of the armies of the United States (one rank above the five-star generals of World War II). Pershing retired from active duty in 1924, at the age of 64. Although declining health prevented much active public service, he was an advisor on military matters until his death on July 15, 1948, at 88.

Entrance to Gen. Pershing's boyhood home is by paid guided tour. The tour takes visitors to each room of the rural Gothic

1952, the Pershing Park Memorial Association purchased and donated the house to the state of Missouri, to be restored and maintained as the Gen. John J. Pershing Boyhood Home State Historic Site. It was dedicated to the memory of the general and to the soldiers who fought under him in World War I. The dedication took place on Sept. 13, 1960, as part of a national centennial celebration to honor Gen. Pershing. As part of the event, the U.S. Army brought a model of one of the first missiles to Laclede. The "Pershing Missile," was christened in honor of the man who built the framework of our modern armed forces during World War I.

A visit to the Gen. John J. Pershing Boyhood Home State Historic Site also includes Prairie Mound School, where Pershing taught. The one-room school, which was moved to the area where the house is located, features a new exhibit that takes visitors through the many doorways that Pershing passed through during his life.

On the grounds of the Pershing home is a statue of General Pershing. A semicircle of granite tablets naming notable veterans of previous wars, called the Wall of Honor, surrounds the statue.

For more information, contact the site at (660) 963-2525 or DNR toll free at 1-800-334-6946 (voice) or 1-800-379-2419 (Telecommunications Device for the Deaf).

Margaret Neeley is the site administrator at [Gen. John J. Pershing Boyhood Home State Historic Site](#) within DNR's [Division of State Parks](#).

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Going with the Flow

Urban Stream Management Takes a More Natural Course

by Linda Vogt

photographs by Intuition & Logic, St. Louis

"That stream. It eats into its banks, jumps its channel, meanders around like a mad person. It's out of control. Do something about it!"



Severe bank erosion due to channel incision has become a serious problem in some streams that run through urban areas. Photos by Intuition & Logic, St. Louis

Dump some cars in there. Roll some rocks into it. Line it with some concrete.

For many years, this has been the response to streams that "misbehaved." Landowners dumped rubble, automobiles, even lawn debris on failing banks. They operated on the theory that covering the bank kept the water from getting at it. Cities straightened the channels and lined them with concrete or riprap – large chunks of quarried stone. They worked on the principle that a wide, straight, concrete-lined channel

got the water out of town faster so that it did not hang around the neighborhood and cause trouble. All that energy from moving water had to go somewhere, and it eroded the bed and banks downstream causing higher flood levels elsewhere. Eventually, the concrete fell apart and local governments were left with an eyesore and huge repair costs. Anyway you looked at it, it was not a pretty solution.

Fortunately, the science of stream management is evolving. Assisted by funding from the Missouri Department of Natural Resources (DNR) through a grant to demonstrate

innovative solutions to nonpoint-source water quality problems, the knowledge and tools to move into a new era of stream management are at hand. In that effort, the city of Maryland Heights, in northwest St. Louis County, is taking the lead in Missouri. "Once we were convinced that we could restore back to a natural setting and that it would last, it was an easy decision," said Michael O'Brien, mayor of the city of more than 25,000 people. "And the cost-effectiveness of the process allows us to do more work." Estimates to restore the stream using natural channel design ranged from one-half to two-thirds the cost of more conventional techniques.

In 1960, the Midland Creek watershed in Maryland Heights was largely agricultural. Streams followed meandering courses and still were connected to floodplains, which provided "storage" for floodwaters. However, during a period of 30 years, the city grew and became heavily urbanized. Streams were relocated and straightened while trees and vegetation were removed from the banks. Houses were constructed within 50 to 75 feet of the streams with outbuildings and fences perched at the very edges of the banks.

These manipulations of some parts of a stream can cause the entire system to unravel. For example, one of the effects of straightening a stream is that the channel becomes "incised," that is, extremely eroded in the streambed. In Maryland Heights, residents remembered when they could step across Midland Creek to visit their neighbors. Now, the channel has cut vertically at least 15 feet. That is called incision, or downcutting. Stream incision is a problem not only in Maryland Heights, but in many other places in Missouri.

As the channel cuts downward, bank heights become greater. Erosive forces may undercut them or the steepness of the slopes may cause them to fail. Unfortunately, these bank failures have long been treated as isolated events, and accepted methods of treatment have been to stabilize them by placing riprap or building concrete walls on the bank. If the real problem is that the bottom of the stream is cutting downward, the stream will continue to downcut and the armoring will just slide into the stream.

As the bank erodes into the stream, the channel becomes wider, and sediment is washed downstream. Water quality degrades as the stream becomes shallower, the temperature rises from increased direct sunlight and oxygen levels in the stream drop. This makes it harder for most aquatic life to survive. Stream widening also can affect property - as the bank is washed away, property on the edge goes with it. At that point, local governmental officials usually are called in to fix the problem. Unfortunately, unless the situation is diagnosed correctly, any fix will only be a temporary solution.

In Midland Creek, Steve Gough of Little River Research & Design used his expertise in fluvial geomorphology to determine the cause of the stream's problems. Fluvial geomorphology is the science of how moving water shapes the land. Gene Rovak of Horner & Shifrin Inc. performed the hydraulic analysis, the study of water in motion. Both disciplines are critical to any successful stream restoration. Armed with sound

scientific information, Robert Prager, P.E., and Munsell McPhillips, Ph.D., of Intuition & Logic, designed a series of repairs that would restore the stream to a more natural function. These firms are located in the St. Louis area.

Until the channel bed is stabilized, it does little good to try to solve the bank problems. To provide vertical stability to the stream, Prager and Gough designed five structures called "grade controls." Grade controls generally are constructed from hard materials such as large rock that will not erode or be moved by the forces of the stream. These materials are strategically placed below an area in the stream where the channel is likely to erode, and across the streambed to stop the downcutting from traveling further upstream. Another advantage to these structures is that they can approximate the pool-riffle sequence of natural streams.

Eroding banks now can be stabilized using bioengineering techniques. Bioengineering combines mechanical, biological and ecological concepts to prevent slope failures and erosion. Bare root stock, stems, branches or trunks of living plants are planted on eroded slopes. As these plantings take root and sprout foliage, they reinforce soil. Vegetation may be combined with structural elements such as gabion baskets, which are wire structures filled with rocks, or large rock. However, the intent is to minimize hard structural solutions and allow the rooted plantings to do much of the work to hold the soil in place.

Because Midland Creek is in an urban area and lined with homes, the city needed the stream to stay in place and be confident that it would do so for a long time. Therefore, the design team used two interesting techniques, more structural in nature, but which would still grow into a vegetated stream corridor.

The toe of a stream bank (where the bank meets the stream bed) receives the most erosive force from the water and therefore is the most likely to be eroded enough to cause bank failure. It must be secured. The city constructed a living cribwall for about 540 feet at the creek bed. A cribwall is a hollow, interlocking box arrangement of untreated logs or timber that is filled with soil. Its main function is to prevent toe cutting while promoting the growth of vigorous vegetative cover. Layers of live branch cuttings take root inside the crib structure and extend into the slope. Upper areas of the slope are secured with an erosion blanket and vegetation.

A combination of rock, vegetation and other materials were used to restore more than



Composite revetment involves reinforcing stream banks with layers of rock, mesh fabric, soil and plants. (Top) A bank where composite revetment is newly completed has much of the stress borne by the rocks and mesh. (Bottom) Later, the plants provide stabilization. Photos by Intuition & Logic, St. Louis

800 feet of bank with extremely steep slopes. In this technique, called composite revetment, layers of rock, polyester mesh fabric, soil, live woody plants and mulch reinforce the slope. At first, most of the stress on the slope is borne by the rock and mesh. As the plants become established, the roots take on more of the soil reinforcement and the top growth protects the slope through evaporation and transpiration (water lost to support living plant functions) and shielding from raindrops that dislodge soil particles. Other tools used were coir logs, round logs of coconut fiber, and wattling, or bunches of branches.

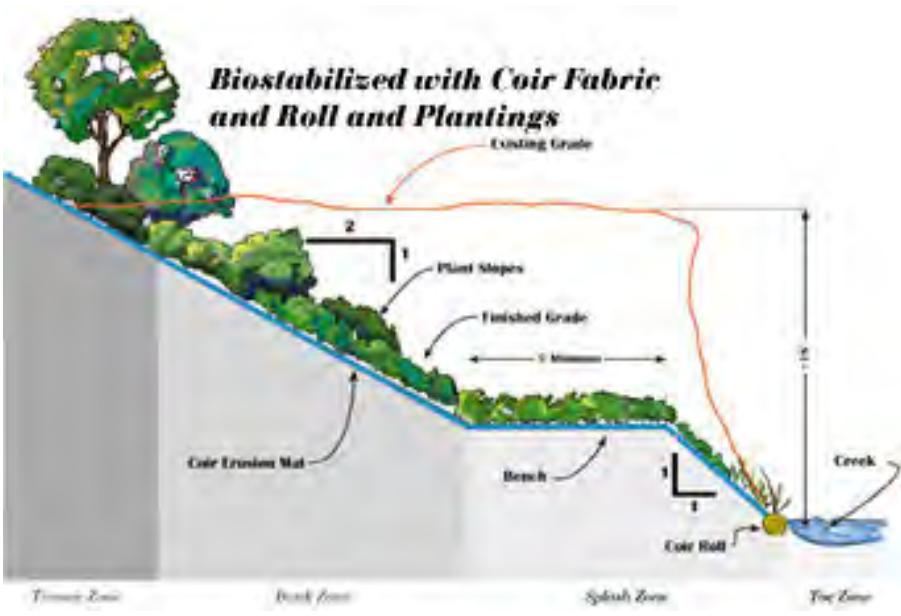
Intensive channel manipulation also eliminates a natural channel shape. A low-flow channel characterizes many stable, natural streams. This channel, sized by natural forces, carries the amount of water from a rainfall event that occurs about every 1.5 to 1.8 years. It is called the stream-forming flow because it exerts the greatest influence on channel geometry. In streams formed by natural processes, the low-flow channel generally is bounded by a bank-full floodplain, a surface below the top of the bank that floods when water levels exceed the amount that can be carried by the low-flow channel.

Under high-flow conditions, these floodplains, in effect, make a wider channel. Higher water levels use the wider channel, which not only provides for greater flow passage, but also slows the velocity of the water and puts less stress on the upper banks of the stream. Nature can come up with some clever engineering! In stream restoration, the design of the stream channel cross-section should account for these processes to ensure long-term stability of the channel. On a short reach of the stream, the restoration design included a two-stage channel with a series of small bank-full floodplains to more closely recreate a natural shape for the channel.

A reality of cities is that a primary task of urban streams is to convey storm water. The construction of a concrete, trapezoidal channel manages this one task, but all other stream values – aesthetics, water quality, aquatic life – are sacrificed. The design for Maryland Heights still had to address storm-water management. However, the stream had incised so deeply, the size of the channel actually was large enough to carry a 500-year flood. Although these techniques also can be applied where localized flooding is a problem, out-of-bank flows were not a problem on Midland Creek.

To manage storm water from an urbanized landscape, Horner & Shifrin Inc. designed drainage swales at the top of the bank. Collected in the swale, most of the storm water flows to area inlets while some infiltrates a layer of soil and flows to the stream through a series of perforated pipes. This prevents the erosive force of storm water from running over the bank and cutting gullies to the stream, also a source of bank instability in Midland Creek.

Nature again has developed its own innovations for managing storm-water volume. According to



meander somewhat within its channel, but it stays in relatively the same place except during extreme natural events. McPhillips stresses that the restoration of Midland Creek is "not a lifetime commitment of keeping the project exactly the way that it was when it was built." Maintenance mostly consists of managing vegetation density by occasional thinning or replanting, removal of harmful invasive species, and in extreme cases, treatment of disease or infestation.

However, the stream must remain in place. Studies conducted a year after the stream restoration show that the channel incision has been arrested. In the first year of the project, the stream survived a 10-year rain event, a level of flow that has a one-in-ten chance of occurring each year. Further studies will be continued past the project life to detect any shifting of the banks.

After the restoration project, backyards abutted a new stream with a border of native trees, shrubs and wildflowers. Because the project was in an urban area, this buffer, or riparian corridor, sometimes shrank to 30 feet, less than a recommended width for water-quality protection. Still, it would provide many benefits to water quality and aquatic life. Trees provide welcome shading to moderate water temperatures.

When many urban areas are faced with stream problems similar to Maryland Heights', engineers have designed hard and straight structures of concrete, gabion baskets or riprap. Many years ago, Maryland Heights tried some of those techniques on Midland Creek. The damaged remains are still visible. Two preliminary designs on the new project proposed those old techniques once again. This time, the city chose a different direction, and the aesthetic quality of the neighborhood is enhanced with a natural stream, which in turn, enhances property values of the residences.

Using this "natural method" costs much less than a traditional concrete-lined system. Construction cost often is reduced by 50 percent using the natural method. The 85

McPhillips, it provides seven or eight different methods to reduce the volume and severity of storm flows through a stream. For example, 11 percent of the rain that hits a deciduous tree never reaches the ground. This amount is intercepted and used by the tree or evaporates.

Left alone, the forces acting on a stream that determine its shape and flow pattern become a natural balancing system. The stream may

percent construction and 15 percent design costs of a concrete-lined system are much higher than the natural-method costs of about 40 percent for construction and 30 percent for design. Design costs are approximately doubled, but the lower construction costs mean huge savings. A \$100,000 project would cost \$70,000 using the natural method, allowing a \$30,000 savings. An added benefit is the natural method can last much longer than concrete, which can deteriorate and wash out.

The use of both bioengineering techniques and fluvial geomorphology as a basis for stream restoration in urban areas is still somewhat new in Missouri. Steve Gough says, "Bioengineering can only be successful if the underlying causes of stream instability – in this case incision – are addressed. By using a team including civil engineers, a biotechnical engineer and a fluvial geomorphologist, the success rate has been high."

Because of the success of this project, the city of Maryland Heights has adopted these two disciplines as the basis for managing its streams. Already, more than 75 percent (11 miles) of the surface waters of Maryland Heights have been evaluated using the same methods.

Rovak noted the response of the people who live next to Midland Creek, "The stream went from an out-of-sight, out-of-mind eyesore that was a threat to people, and now is something people can see and want to be around. It is no longer the enemy that eats their backyard."

Recently, as DNR project manager, I walked the stream with staff from the city of Maryland Heights, project designers and consultants. Fish, such as black stripe minnows, smallmouth bass and green sunfish, were abundant in the small pools. A little green heron flew ahead of us. Kingfishers, prothonotary warblers and numerous other birds that live along wooded stream corridors have returned to enjoy the thriving natural habitat. As we climbed up the bank and pushed aside tree limbs and plant leaves, somebody joked, "Hey, you planted too many plants!"

Region VII of the U.S. Environmental Protection Agency, through DNR, provided partial funding for this project under Section 319 of the Clean Water Act. The purpose of these funds is to provide innovative solutions for the prevention and control of nonpoint-source water pollution. The city of Maryland Heights provided funding from a local one-half-cent sales tax for parks and storm-water management, approved by its voters in 1996.

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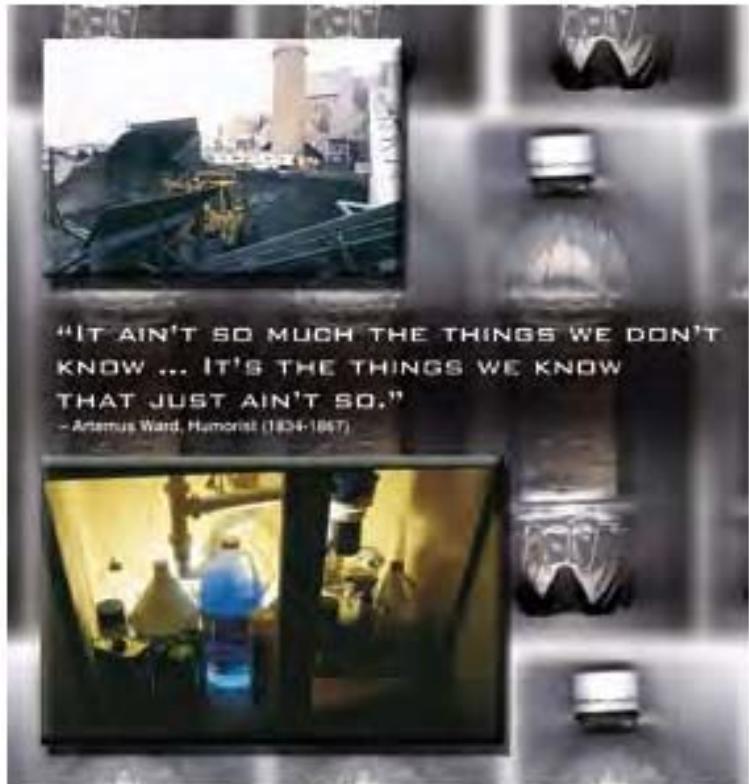
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Teacher's Notebook

FACT OR FICTION? TEST YOUR E-IQ

by Steve Schneider



Myths about electrical generation, bottled water and household chemicals abound. Worse, many end up being widely held beliefs.

Myths about electrical generation, bottled water and household chemicals abound. Worse, many end up being widely held beliefs.

Recycling, wildlife entanglement and oil spills receive much media coverage. Unfortunately, brief sound bites often blur the facts. With the many forms of media Americans can now access, more information is readily available now than at any other time in history. But as our data banks have grown, so has our access to misinformation.

The National Environmental Education and Training Foundation (NEETF) is a private nonprofit organization authorized by Congress through passage of the National Environmental Education Act in 1990. In 1997, NEETF, with Roper Starch Worldwide, assessed

the environmental literacy of American adults. The survey showed that only one in three adults had a passing grade on environmental issues.

NEETF wanted to know if this low literacy assessment resulted from lack of knowledge or from misinformation. To determine if Americans could distinguish between environmental myths and truths, a 1998 survey was drafted that contained multiple-choice questions with a myth answer, two plausible but incorrect answers and one correct answer. An environmental myth is popular but outdated or incorrect information about an environmental issue or problem. The majority of Americans surveyed gave the myth answer in three of the 10 environmental myth questions. The average score for American adults was 22 percent correct. The probable score for random guessing was 25 percent (NEETF/Roper Survey, 1998).

Myths and Facts

The 1998 NEETF/Roper results suggest there is misinformation concerning the environment. The following summarize the report's findings regarding Americans' belief in environmental myths:

Water Pollution – Nearly half think the leading cause of water pollution is factories. Only one in five identifies nonpoint-source pollution (runoff) as the leading cause.

Chlorofluorocarbons (CFCs) – Many think ozone-depleting CFCs come from aerosol cans (CFC use in spray cans was banned in 1978). Only one in three realizes refrigerants (freon) are the major source.

Household Chemicals Safety Testing – The majority assume the government screens household chemicals for safety. No federal agency has this responsibility.

Generating Electricity – The majority think that electricity is produced in non air-polluting ways, mostly by hydroelectric power. Only one in three views coal burning as related to electricity. In fact, 70 percent of electricity is generated from burning coal and other fossil fuels.

Spent Nuclear Fuel – Many think spent fuel from nuclear plants goes in a deep underground storage facility out West. Just one in six knows permanent storage has yet to be found and current storage is on the plant site.

Landfill Waste – Many view disposable diapers as the main source of waste in landfills. Just one in four sees paper as the larger issue.

Recycling – Most believe the main benefit of recycling is saving trees. Only one in four realizes it reduces the amount of waste headed for landfills.

Childhood Death – Famine is believed to be the leading cause of childhood death worldwide. Only one in 11 knows waterborne microorganisms are the leading cause.

Oil Spills – Only one in seven knows that improper disposal of do-it-yourselfer used oil is the main source of oil polluting water. Most think the sources are oil rigs, refineries and tankers.

Wildlife Entanglement – Only one in 10 knows fishing line is the culprit. Most think plastic six-pack rings are the leading cause of wildlife entanglement.

Bottled Water Testing – The majority think bottled water is routinely tested by the federal government for safety and purity. It is not. Regulations on bottled water testing vary from state to state.

Definition of a Watershed – Only two out of five are able to identify the term watershed as a land area that drains into a body of water.

While government intervention is questioned in many arenas, Americans largely support government programs focused on the environment. Even with strong support for the environment, Americans' belief in myths could lead them to support nonissues, fail to support real issues or set inappropriate priorities among issues.

Why Myths Exist

Environmental myths are prevalent because Americans rarely question the validity of information or its source(s). They usually are not able or willing to critically review that information.

The media play a key role in informing the public about the environment. Environmental issues are complex and thorough, consistent coverage is simply too time consuming or requires too much space.

A 1992 Missouri Department of Natural Resources (DNR) survey revealed the primary sources of environmental information for Missouri adults were newspapers and television. A 1994 NEETF national survey provided similar results for the primary sources of environmental information for young people (NEETF/Roper Youth Report, 1994). In descending order of significance, the youth sources were television, school, newspapers and family.

Critical thinking skills also need improvement. Critical thinking is not just criticism of an idea or issue, but includes both merits and faults. Without a basic understanding of the environment and the ability to think critically, citizens are less likely to consider the claims of various policy advocates and more likely to buy into simplistic or self-serving solutions.

What Can Environmental Educators Do about Myths?

Myths cloud the public's understanding

of issues, possibly misguiding or misusing the strong public support for environmental protection. Educators must not assume the public knows more than it really does about environmental issues.

Teachers play a critical role in ensuring that students use reliable sources of information on the environment. Environmental educators want to encourage behavior that has a minimal impact on the environment and help independent thinkers make informed decisions on environmental issues.

Students must be able to determine that popular positions are not always informed positions. Investigating environmental issues provides opportunities for students to develop critical-thinking, problem-solving and decision-making skills.

Conclusion

During the seven years of assessment including the 1998 report, environmental support remained consistently high. Correspondingly, 95 percent of adults supported environmental education in schools (NEETF/Roper, 1997).

The low scores seem to suggest that Americans are inclined to make at least some environmental decisions on how they feel rather than on what they know.

All of us are continually required to make vital decisions on environmental issues. If we are to make responsible and informed environmental decisions, we must have fundamental knowledge of basic environmental concepts and processes. This enables all of us to make valid assessments of environmental issues and take part in shaping environmental policies.

For information on the National Environmental Education and Training Foundation, check out its Web site at [<http://www.neetf.org>].

Steve Schneider was an environmental education specialist in [DNR's Division of Environmental Quality](#) and recently retired after 26 years with the department and five years as a secondary school science teacher.



Recycling, wildlife entanglement and oil spills receive much media coverage. Unfortunately, brief sound bites often blur the facts.

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Starting with our spring issue of *Missouri Resources*, we will begin publishing selected, historic photos from our readers. Only photos from before 1970 will be considered. Submissions should highlight Missouri's natural, cultural and historic resources or related events (even weather), historic buildings and their surroundings. We remind our readers that, unfortunately, space limitations will allow us to use only one picture per issue, four per year.



Bagnell Dam is one of Missouri's best-known hydroelectric facilities. This construction photo by Stone and Webster Engineering Corp., which designed and built the dam for the Union Electric Light and Power Co. (now AmerenUE) of St. Louis, was taken in October 1930. Construction of the dam began on Aug. 6, 1929. Lake of the Ozarks began to fill Feb. 2, 1931, and the roadway over the dam was opened to traffic on May 30, 1931. Photo from "Lake of the Ozarks: The Early Years," by Dwight Weaver.

waterways are suitable examples of environmental events from Missouri's past.

The following information is desirable but not mandatory: When and where the shot was taken, who took it, who is in it, a brief description as well as any related, historic details that might offer our readers additional insight or perspective. All photos will be returned.

Send your photo to: Time Exposures, c/o *Missouri Resources*, P.O. Box 176, Jefferson City, MO 65102-0176. Make sure to include your return address.

We will consider shots of wildlife in their natural surroundings, but hunting and fishing photos will not be accepted since these do not fall under our mission or jurisdiction. Your photo need not be a "pastoral postcard shot" either. Floods, earthquakes, erosion, air pollution, environmental spills and polluted